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APPLICATION OF LANDSAT-2 TO THE MANAGEMENT OF DELAWARE'S MARINE AND WETLAND RESOURCES

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A. PROBLEMS

Funds in our account for purchasing LANDSAT imagery at NOAA/EDS/Satellite Data Services Branch and at the EROS Data Center of Sioux Falls, have been exhausted. A small increase in the NOAA/EDS and EROS Data Center accounts would cover our data requests for the remainder of the contract.

B. ACCOMPLISHMENTS

1. General

Status of each objective is shown in terms of percentage of tasks completed.

Study Objectives	Status
1. Monitoring the dispersion and movement of ocean dump plumes. (Work Statement Tasks 1, 2, 3 and 4.)	75%
2. Suspended sediment concentration mapping. (Work Statement Tasks 5, 6 and 7.)	80%
3. Current circulation and density front charting for a model which predicts the drift and dispersion of oil slicks. (Work Statement Tasks 8, 9, 10 and 11.)	100%
4. Coastal land use and vegetation studies. (Work Statement Tasks 12, 13 and 14.)	100%
5. Comparison of training site and spectral signature (with atmospheric correction) techniques for classifying coastal land cover and environmental impact. (Work Statement Task 15.)	80%
6. Impact of Outer Continental Shelf development on the coastal zone of Delaware. (Work Statement Tasks 16, 17 and 18.)	60%

Most of the results attained were presented in progress reports, recent publications (Ref. 2 through 10), and LANDSAT follow-on evaluation reviews at NASA-Goddard Space Flight Center, NASA Langley Research Center, and NASA Headquarters (Ref. 11, 12 and 13).

2. Variability of Wetland Reflectance and Its Effect on Automatic Categorization of Satellite Imagery

A technique for training automated analysis of satellite (LANDSAT) multispectral data based on *in situ* measurements of target reflectance was tested and applied in delineating cover types in Delaware's tidal wetlands. The technique evaluated uses *in situ* measurements of target radiance and an atmospheric correction procedure to derive reflectance signatures for land-cover categories in preference to the relative radiance signatures traditionally derived from training samples within the satellite data itself.

Land cover categorization of data from the same overpass in four test wetland areas was carried out using a four-category classification system. The tests indicate that training data based on *in situ* reflectance measurements and atmospheric correction of LANDSAT data can produce comparable accuracy of categorization to that achieved using more than four wetlands cover categories (Salt Marsh Cordgrass, Salt Hay, Unvegetated and Water Tidal Flat) produced overall classification accuracies of 85% by conventional and relative radiance training and 81% by use of *in situ* measurements. Overall mapping accuracies were 76% and 72% respectively. Further refinement of the atmospheric correction and ground measurement procedures should produce even better accuracies in more operational mode.

In addition, field measurements showed that variability in spectral reflectance was, as expected, symptomatic of significant physical characteristics of the test cover types such as time elapsed since tidal inundation of mud, plant height and growth form. Significant correlations were found between single band reflectances and tidal inundation and plant morphologic characteristics. Optimization of seasonal sampling procedures for detection of plant morphologic parameters is suggested.

C. SIGNIFICANT RESULTS

Distribution and Concentration of Suspended Matter in Delaware Bay

In a single LANDSAT scene, if the atmospheric conditions are essentially constant over the scene, changes in upwelling radiance from the water are essentially related to the relative strength of absorption and scattering by the water. The usual measure of t.. s relative strength is the single scattering albedo w_o which is the percentage of light removed from a beam by scattering. The problem of remote sensing of suspended matter in water was analyzed in terms of the single-scattering albedo and a semi-empirical relationship between satellite radiance measurements and the concentration of suspended matter in the water was developed. The relationship was tested using data from the 7 July 1973 LANDSAT overpass of Delaware Bay with good results.

D. PUBLICATIONS

1. Klemas V., Invited presentation to Captain Jacques Cousteau and Dr. Philippe Cousteau on Ocean Current Measurement with Integrated Drogue-Aircraft-Satellite Systems, NASA Headquarters, Washington, D. C., October 6, 1975.

2. Klemas, V., Bartlett, D., Rogers, R., Coastal Zone Classification from Satellite Imagery. Photogrammetric Engineering and Remote Sensing, Journal of the American Society of Photogrammetry, Vol. 41, No. 3, April, 1975.

3. Klemas, V., Otley, M., Wethe, C., Rogers, R., ERTS-1 Studies of Coastal Water Turbidity and Current Circulation, American Geophysical Union 55th Annual Meeting, Washington, D. C., April 8-12, 1974.

4. Klemas, V., Tornatore, G., Whelan, W., A New Current Drogue for Monitoring Shelf Circulation, American Geophysical Union 56th Annual Meeting, Washington, D. C., June 16-20, 1975.

5. Klemas, V. and Bartlett, D., Application of ERTS-1 and Skylab to Coastal Zone Management, NASA Earth Resources Survey Symposium, Houston, June 8-13, 1975.

6. Klemas, V., Davis, G., Wang, H., Whelan, W., Tornatore, G., A Cost-Effective Satellite-Aircraft-Drogue Approach for Studying Estuarine Circulation and Shelf Waste Dispersion, Proceedings Ocean 75 Conference, San Diego, 1974.

7. Klemas, V., Davis, G., Wang, H., Whelan, W., Monitoring Estuarine Circulation and Ocean Waste Dispersion Using Integrated Satellite-Aircraft-Drogue Approach, International Conference on Environmental Sensing and Assessment, Las Vegas, September 14-19, 1975.

8. Klemas, V., Remote Sensing of Wetlands Vegetation and Estuarine Water Properties, Proceedings Third International Estuarine Research Conference, Galveston, October 6-9, 1975. (Invited paper)

9. Eight reports on significant results to NTIS.

10. Klemas, V. and Polis, D. F., Remote Sensing of Estuarine Fronts and their Effects on Oil Slicks, University of Delaware Publication CMS-Rann-4-76, 48 pp., 1976.

11. LANDSAT follow-on investigation interviews conducted at NASA Goddard Space Flight Center, Greenbelt, Md. on October 18, 1976.

12. Review of Basic Research in NASA-related Environmental Quality Monitoring held at NASA Langley Research Center, Hampton, Va. on December 8, 1976.

13. NASA Headquarters Review of task on comparison of training site and spectral signature techniques for classifying coastal land cover, Washington, D. C., March 31, 1977.

14. Bartlett, D. and V. Klemas, Variability of Wetland Reflectance and Its Effect on Automatic Categorization of Satellite Imagery, Proceedings of the American Society of Photogrammetry, 43rd Annual Meeting, Washington, D. C., February 27-March 5, 1977.

E. RECOMMENDATIONS

Add more money to NOAA/EDS and EROS Data Center accounts.

F. FUNDS

On schedule for Objectives 1, 2, 3 and 4. Insufficient for Objectives 5 and 6.

G. DATA USE

All ordered LANDSAT-2 tapes have been received so far. They have been evaluated and are currently being analyzed.

H. AIRCRAFT DATA

Aircraft overflights have been on time and on target. Most of the imagery has been received and more imagery is on order.

I. PERSONNEL CHANGES

None.